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ABSTRACT

This paper examines whether an illiterate worker's earnings are affected by the literacy of other members of the household. Theory suggests that a member of a collective-action household may or may not share knowledge with others in the household. Shared income gains from shared knowledge may well be offset by a shift in the balance of power within the family. To determine whether literate persons share the benefits of literacy with other household members in practice, data on urban males and on rural males and all females with primary earnings from the nonagricultural sector were drawn from Bangladesh's 1995-96 the Household Expenditure Survey for Bangladesh, 1995-96. For both married and unmarried illiterate working women, living in a literate household greatly increased earnings. However, illiterate women's labor force participation was decreased in a literate household. Illiterate males, in both urban and rural nonfarm sectors, benefitted from living in a literate household but their increase in earnings was much smaller than those of women and became insignificant among unmarried men. The findings suggest that illiterate females are better able to absorb the benefits of literacy than are illiterate males. (Contains 16 references.) (SV)

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ED 437 250

Is Knowledge Shared Within Households?

Kaushik Basu, Ambar Narayan, and Martin Ravallion[1]

World Bank

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[1] The paper is an output of the World Bank research project, 'Literacy and Child Labor' (RPO 683-07).

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2261. Is Knowledge Shared within Households?

Kaushik Basu, Ambar Narayan, and Martin Ravallion
(December 1999)

Yes - and more efficiently by women than by men, according to this analysis of household survey data for Bangladesh. An illiterate adult earns significantly more in the nonfarm economy when living in a household with at least one literate member.

According to theory, a member of a collective-action household may or may not share knowledge with others in that household. Shared income gains from shared knowledge may well be offset by a shift in the balance of power within the family. But do literate members of the household share the benefits of literacy with other members of the household in practice?

Using household survey data for Bangladesh, Basu, Narayan, and Ravallion find that education has strong external effects on individual earnings.

When a range of personal attributes is held constant, an illiterate adult earns significantly more in the nonfarm economy when living in a household with at least one literate member. That is, a literate person is likely to share some of the benefits of his or her literacy with other members of the household. It is better to be an illiterate in a household where someone is literate than in a household of illiterates only.

It is widely noted that a literate mother confers greater benefits on her children than a literate father does. But what about differences between male and female recipients of knowledge? The empirical results suggest that women are more efficient recipients, too.

This paper - a joint product of the Office of the Senior Vice President and Chief Economist, Development Economics, and Poverty and Human Resources, Development Research Group - is part of a larger effort in the Bank to understand the relationship between literacy and balance of power in the household. This paper was funded by the Bank's Research Support Budget under the research project "Intrahousehold Decisionmaking, Literacy, and Child Labor" (RPO 683-07). Copies of the paper are available free from the World Bank, 1818 H Street, NW, Washington, DC 20433. Please contact Michelle Mason, room MC4-322, telephone 202-473-0809, fax 202-522-1158, email address **mmason1@worldbank.org**. *The authors may be contacted at* **kb40@cornell.edu**, **anarayan@worldbank.org**, *or* **mravallion@worldbank.org**. *(26 pages)*

1. Introduction

This paper asks whether an illiterate worker's labor earnings are affected by the educational attainment of *other* members of that worker's household. The large literature on literacy says very little about intra-household externalities of literacy and education. Yet one might well expect that one person's literacy will have spillover benefits for another within the same household. In their study of the propensity to innovate among Guatemalan farmers, Green, Rich and Nesman (1985) observe how having a literate family member is like being partly literate oneself. Likewise, Drèze and Saran (1995) note how the advantages of literacy can spread to others in the household by virtue of certain kinds of decision-making on behalf of the household shifting toward the literate.

In Basu and Foster (1998) an attempt was made to develop a measure of literacy which captures these natural externalities.[1] That paper adopted an axiomatic approach. The crucial idea captured by the axioms was that a literate household member confers benefits on illiterate members. Let us, in particular, partition the illiterate members of the society into two categories: the *proximate illiterate*, that is, an illiterate person who lives in a household in which at least one person is literate, and the *isolated illiterate*, that is, an illiterate who lives in a household of all illiterates. It is arguable that a proximate illiterate is significantly better off than an isolated illiterate (though of course it is best to be literate oneself). The reason is that, for certain activities, all one needs is an easy access to a literate person. For instance, an illiterate farmer who occasionally receives pamphlets from extension workers or needs to read the label on a new fertilizer packet could benefit enormously from such access. An urban worker whose work entails some knowledge of what is happening in the world at large or just plenty of 'commonsense', which comes from interacting with knowledgeable people, might benefit a lot

from having a literate person at home. Of course, employers, being aware of this, will be willing to pay more for a proximate illiterate than for an isolated illiterate.

What evidence is there that education has an external effect within the family? One external effect of education within families has been well researched empirically, namely the effect of parental education on child welfare. There is a large body of evidence indicating that children's nutritional status and educational attainments are enhanced by having better educated parents.[2] However, we know much less about the effect of one adult's education on the earnings of another adult within the same family. One of the few exceptions is Benham (1974) who found evidence in U.S. data that men's earnings respond positively to their wife's schooling as well as their own. We aim here to test for external effects for both men and women in rural Bangladesh. We turn deliberately to a developing country setting in which there are large disparities in educational attainments, in the expectation that we will make it easier to identify any external effects of education. We examine the efficacy of men versus women as recipients of the externality of literacy. It is believed that women are better at generating positive externalities within the family, and there is supportive evidence.[3] However, there does not appear to have been any research on whether women are better or worse as the *recipients* of externalities. Does the presence of a literate member in the household yield significantly greater externalities on illiterate women than on illiterate men?

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[1] For critique and extension of this measure, see Subramanian (1999).

[2] For a survey of the evidence see Strauss and Thomas (1995). In a recent example, Gibson (1999) finds strong effects of adult literacy on children's nutritional status in Papua New Guinea. In the same Bangladesh data set that is analyzed here there is evidence that children of better educated parents are more likely to attend school (Ravallion and Wodon, 1999).

[3] A number of studies have suggested that women share their education and other advantages with others in the household more than do men; for further discussion and references to the literature see Strauss and Thomas (1995).

We begin by examining a key theoretical question: Given that a literate member can, if she so chooses, prevent others from benefiting from her literacy, why does she not do so? Moreover, can there be reason for men and women to have different propensities to share? The following section constructs a theoretical model to answer these questions. The paper then tests for literacy sharing within households. Section 3 describes our data for Bangladesh. Section 4 describes the wage regressions that we estimate across illiterate sub-samples of the workforce, correcting for sample selectivity bias. In addition to reasonably standard variables for earnings regressions, we include measures of the highest education level in the worker's household. We stratify the regressions by gender and employment sector (subject to data limitations) in the expectation that external effects will be stronger for certain types of jobs. Section 5 presents the results, and section 6 consists of concluding remarks. A detailed Statistical Addendum is available from the authors.

2. Why might there be external effects of education within households?

It is not obvious on *a priori* grounds that a literate person will share the advantages of literacy with the illiterate members of the same household. The benefits of literacy are, by and large, non-rival but excludable. They are non-rival because for a literate member to read a brochure for an illiterate or to give the illiterate a piece of information he already possesses is virtually costless. In a household one can, for instance, exchange such information over dinner or while doing household chores. They are excludable because a literate member can, if he so chooses, refuse to part with any information. It is true that some of the benefits can be acquired just by osmosis, by watching, for instance, what he does with the new fertilizer; but nevertheless the literate person can block a lot of the benefits if he wants to. So why would we expect him to share knowledge with other members of the household?

In answering this, we could directly appeal to altruism and treat that as the end of the matter. Interestingly, it is possible to go deeper. The new literature on household decision-making (see, for instance, Udry, 1996; and Quisumbing and Maluccio, 1999) has lots of disputes, but one proposition generally agreed upon is that there is some pooling of resources and earnings in most households. There are the household public goods like the common kitchen, which benefit from anybody's rise in income. Then there are the shared tasks, such as one person belonging to the household or hired by the household going to the market to shop for everybody. This means that if individual i can raise individual j's income by conferring some of his literacy advantage to j, a part of the gain will come back to i through the sharing process. However, one has to balance against this the fact that a higher income will empower the illiterate members and may alter the expenditure pattern of the household. If preferences differ sufficiently between literate and illiterate people then a shift in power within the household associated with shared literacy advantage can work against the interests of the literate family member, who will then naturally be disinclined to share the advantages of literacy. To get a grip on these conflicting effects it is useful to construct a model.

In our model, the household collectively chooses its consumptions, but literate members are free to restrict illiterate members from enjoying the advantages of literacy. Whether literate members choose to help illiterate members of the same household depends on their personal utility gains, which in turn depend on how sharing the literacy advantage alters the level and composition of household consumption. This depends on two potentially opposing effects. The first is a positive income effect of sharing literacy on consumption, through higher earning potential of the illiterate members. The second is a potentially negative effect (from the point of view of the literate members) on the composition of consumption, via effects on the balance of

power within the household, given differences in preferences. How these two effects balance out determines whether there will be an external effect of literacy within the household.

Let us, for simplicity, assume that a household has two members, one literate and one illiterate, whose utility functions are, respectively, $U_L(.)$ and $U_O(.)$. Let there be two goods.[4] If x is the vector of goods consumed by the household, then the utilities of the literate and illiterate members are given by $U_L(x)$ and $U_O(x)$. It is assumed that both utility functions are strictly increasing and quasi-concave.

We shall take this to be a 'collective-action household', both because this has been modeled and analyzed in recent times (see, for example, Bourguignon and Chiappori, 1994; Moehling, 1995; Basu, 1999) and because of its flexibility. The latter enables the model to capture households that meet the hard requirements of the unitary model, as one polar extreme, and also of households which are deeply divisive. Recently Basu, Genicot and Stiglitz (1999) have modeled how in times of high unemployment households may send the 'secondary workers' (for instance, children or, in traditional societies, women) out to work. In that case, if the primary worker is literate it is in the interest of the primary worker not to exclude the secondary workers from the externalities of education.

Our model assumes that the household chooses consumptions to maximize a weighted average of U_L and U_O, the weight λ being a function of the illiterate person's income, y_O and the literate person's income, y_L. Since the latter will be assumed to remain unchanged throughout

[4] In a one good version of this model there cannot be a conflict of interest over sharing knowledge since consumption must then be normal with respect to income of the illiterate family member. The fact that utility of the literate family member must then be monotonically increasing in the income of the illiterate member will be adequate incentive for sharing knowledge.

the analysis, we could think of λ to be a function of y_O. It will be assumed that $\lambda(y_O) \in [0,1]$ and $\lambda'(y_O) \geq 0$.

Hence the household's problem is to choose x so as to maximize:

$$\lambda(y_O)U_O(x) + [1 - \lambda(y_O)]U_L(x) \qquad (1)$$

subject to the budget constraint $p.x \leq y_L + y_O$ where $p = [p_1, p_2]$ is the price vector for the two consumption goods. Let us denote the solution of this problem by:

$$x = x(y_O) \qquad (2)$$

(While x depends also on p and y_L, these are assumed to be constant and so are ignored.)

The interesting question is: what will be the value of y_O? This will depend in part on the literate member's decision whether or not to exclude the illiterate member from the externalities of his education. Let y_I and y_P be the income of the illiterate if she, respectively, gets the benefit of literacy and if she does not get it. Of course, $y_P > y_I$. Plainly y_I is the income of an isolated illiterate. What we are saying is that a proximate illiterate who is denied the benefits of her literate householder will have the same income as that of an isolated illiterate.

When will the literate not exclude the illiterate? In other words, when will the literate set $y_O = y_P$? One way of answering this is to think of the household's problem described above to be the period-2 problem. In period 1 the literate member has to choose between setting $y_O = y_P$ or y_I. Clearly, he will set $y_O = y_P$ if and only if $U_L(x(y_P)) \geq U_L(x(y_I))$ where $x(y_P)$ and $x(y_I)$ are given by (2).

Claim 1 : If $U_O(x) = U_L(x)$, then the literate member will not exclude the illiterate member from the benefits.

To verify this, note that if $U_O(x) = U_L(x)$ then the household's consumption choice problem reduces to maximizing $U_L(x)$ subject to $p.x \leq y_L + y_O$. It follows that $U_L(x(y_P)) \geq U_L(\tilde{x})$, for all $\tilde{x}$ such that $p.\tilde{x} \leq p.x(y_P)$. Since the utility functions are monotonic, $p.x(y_P) = y_L + y_P$. Next note that $p.x(y_I) = y_L + y_I$. Hence $p.x(y_I) \leq p.x(y_P)$. Therefore $U_L(x(y_P)) \geq U_L(x(y_I))$, which establishes the claim.

Claim 2 : If $\lambda(y_O) = \lambda$, for all y_O, then the literate member will not exclude the illiterate member from the benefits.

To prove this note that if $\lambda(y_O) = \lambda$ for all y_O then the first-order conditions for the household's period-2 problem are given by:

$$\frac{\lambda.\dfrac{\partial U_O(x)}{\partial x_1} + (1-\lambda).\dfrac{\partial U_L(x)}{\partial x_1}}{\lambda.\dfrac{\partial U_O(x)}{\partial x_2} + (1-\lambda).\dfrac{\partial U_L(x)}{\partial x_2}} = \frac{p_1}{p_2} \qquad (3)$$

and

$$y_L + y_O = p_1 x_1 + p_2 x_2 \qquad (4)$$

From (4) it follows that if y_O increases, one of the following must be true: (a) both x_1 and x_2 rise; or (b) one of x_1 and x_2 rises and the other falls. It is easy to see that if (b) were true, (3) could not be valid. Hence, (a) is true. Hence, both U_O and U_L increase if y_O increases, which completes the proof of Claim 2.

What these results tell us is that in a unitary household it is in the selfish interest of each literate member to spread the benefits of literacy. Note, however, that the household being unitary is a sufficient condition for sharing, not a necessary condition.

Examining the household's problem one can intuitively see that what is necessary for members to share their literacy is something more general, to wit, that they have *similar* preferences, or that the bargaining power, captured by λ, does not change *too* much.

To see this let us consider a special case, where $U_L(x) = x_1$ and $U_O(x) = x_1 + Ax_2^{\alpha}$, with $\alpha < 1$. Note that as A goes towards 0, the two utility functions tend to converge. Further, and, without loss of generality, assume $p_2 = 1$. Thus the household's (period-2) problem is to maximize

$$\lambda(y_O)(x_1 + Ax_2^{\alpha}) + [1 - \lambda(y_O)]x_1$$

subject to $p_1 x_1 + x_2 \leq y_L + y_O$.

This is equivalent to the problem of maximizing:

$$x_1 + \lambda(y_O)A(y_L + y_O - p_1 x_1)^{\alpha}.$$

From the first-order condition we have:

$$x_1 = \frac{y_L + y_O}{p_1} - \frac{[p_1 \lambda(y_O)\alpha A]^{\left(\frac{1}{1-\alpha}\right)}}{p_1} \qquad (5)$$

Inspecting (5) it is obvious that changing y_O from y_I to y_P will increase x_1 as long as $\lambda(y_P) - \lambda(y_I)$ is sufficiently small or A is sufficiently small. Of course, if either of these terms is zero, x_1 must rise.

Note now that if $\lambda(y_P) - \lambda(y_I)$ is small it means that the structure of decision-making changes at most a little in response to changes in the earnings of different members. And if A is small it means that both members have similar preferences; preferences being identical if $A = 0$. From these interpretations it is clear that these are conditions that one would expect in a normal household. It may not be 'unitary', but it is not too divisive either. And when that holds, what

we have just shown is that proximate illiterates will be better off than isolated illiterates. This is the hypothesis we are about to test. From the above discussion it should be evident that the hypothesis meets the criterion of falsifiability. In a sense, what we are testing for is a certain view of the household. If that view is right we would expect to see external effects of education within households, that is $y_P > y_I$. Otherwise not. While we hypothesize that $y_P > y_I$, theory cannot tell us how large the gap will be. So an important purpose of our empirical exercise is to see how large this gap is.

It is easy to adapt the above model and alter the sharing of literacy from being a 0-1 variable to a variable $s \in [0,1]$, where $s = 0$ means not to share at all and $s = 1$ means to fully share. Then we would have the income of an illiterate person in a household where there is someone literate be a function of s. That is, $y_O = y_O(s)$, with $y_O(0) = y_I$, $y_O(1) = y_P$ and $y_O'(s) > 0$.

From our model it is easy to see that a literate person's decision on how much to share, that is, the exact value of s, will depend on the nature of the utility function of the person with whom literacy can be shared. It is reasonable to expect basic differences between the utility functions of men and women. In that case, s, and therefore, $y_O(s)$ will be different depending on whether the benefits of literacy are to be shared with an illiterate man or an illiterate woman belonging to the household. In anticipation of our empirical finding that women are better "recipients" of the externality of literacy, note that if there is a third person in the household, for instance, a child, there can be large natural differences between men and women as recipients of externality. Suppose the woman uses increases in her bargaining power in the household to spend in a way that benefits the child but the man in the same place uses the power to his own advantage. However, if the man (woman) does not get benefits for himself, he (herself, she) prefers that the

benefits go to the child rather than the other adults in the household. Given these plausible assumptions, it is natural to expect that a literate person will be more willing to let the external benefits of his or her literacy flow to a woman rather than a man, since that helps direct more advantage towards the child.

For similar reasons, s and $y_O(s)$ can also depend on other factors that determine the utility functions of the individuals. These factors include whether the person works in the agricultural or the non-agricultural sector, and whether he or she belongs to the urban or the rural sector. What we mean is that there may be systematic differences in the utility functions that prevail in rural and urban households or households in different sectors of the economy. In that case we may find that the externality of literacy depends not only on the gender of the participants but also on the sector to which they belong professionally. Theory of course cannot tell us the exact nature of the differences in s and $y_O(s)$. All theory says is that this is potentially an interesting question. The definitive answer has to come from empirical investigation. And that is what we turn too presently.

3. Data

Our data are from the Household Expenditure Survey for Bangladesh, 1995-96. This is a reasonably comprehensive nationally representative socio-economic survey of 7420 randomly sampled households (comprising 39,043 individuals) in 22 regions comprising of 63 districts, including rural, urban metropolitan and urban municipal areas. The survey results indicate that 61.1% of people in Bangladesh over seven years of age are illiterate (55.7% of males; 66.6% of females). In rural areas, the percentage is higher, namely 65.4% (60.2% of males; 70.8% of females). Bangladesh Bureau of Statistics (1998) provides a detailed description of the survey and summary tabulations of the results.

As a first step, it is important to consider the kind of earnings we would be interested in, given that the data reveal incomes from a wide range of sources. For obvious reasons we are interested in only that part of income which is earned from some form of productive activity. So we exclude incomes derived from personal and individual wealth and assets, from the categories of incomes to be considered. For reasons that are less obvious, we also exclude income from own farms and businesses. The reasons for this exclusion have to do with our objectives as well as with the nature of data. Income from own farms and businesses, we feel, in most cases should be seen as accruing to the entire household rather than to individual members of the household. In such a scenario, education of one or more members of the household is likely to have a direct effect on household earnings and should not be considered a part of the externality effect that we are interested in. Also due to the nature of these earnings, it is often not possible to apportion them between individual members of the household in a satisfactory way, which makes it very difficult to measure the effect of household education on individual earnings. From eyeballing the data we get the impression that farm incomes have been apportioned among various household members somewhat arbitrarily. For instance, it has often been added to the income of the head of the household.

For these reasons we consider only the following categories of earnings: salary and wages received from regular and/or irregular/seasonal employment, in both cash and kind, and professional remuneration. Given our data set, quarterly figures for these categories of earnings are used.

To anticipate our results, we found that the external effects of literacy are confined to non-farm labor earnings, and so this is what we will focus on in the following discussion. Given the type of work involved, we do not find it implausible that the productivity of an illiterate

agricultural workers will be unaffected by whether there is a literate person in their household. Returns to family literacy will presumably appear in less menial non-farm activities. For completeness, however, we also give results for male agricultural laborers in a statistical addendum available from the authors. (There are too few female agricultural laborers in the sample for this to be possible.)

To separate out the sub-samples or groups we are interested in, we identify all illiterate individuals, where illiteracy is defined as being unable to read, irrespective of the level of schooling. The next step is to identify the household each illiterate person belongs to, and construct variables that measure (a) whether anybody is the household is literate and (b) the maximum education level of these households. The variable for (a) is constructed by defining a dummy variable that takes the value 1 if at least one member of the household is literate. Variables for (b) are constructed in the following manner: Using the available figures on individual educational attainment, we define the maximum education level of a household as the educational level attained by the most educated member of the household.[5] Once we derive the maximum education level of each household, we are in a position to define the dummy variables to proxy the educational attainment of each household.

Accordingly, the four educational levels we consider are being able to read, completed Class I and above, Class IV and above, and Class VII and above. The dummy variable takes the value one if that is the highest education attainment in the household. The entire group of illiterate persons is then sub-divided into males and females. The male group is further divided into rural and urban sub-groups, with the latter group comprising of males who live in urban

[5] It is interesting to note that Foster and Rosenzweig (1996) found that the productivity of a household farm is linked to the educational level of the most educated person in the household.

municipal or metropolitan areas. However, the female group is not sub-divided further because of concerns about the sample-sizes.

To summarize, amongst illiterate wage earners whose principal work is in the non-farm sector we consider three sub-groups: (i) urban and rural females; (ii) rural males with primary earnings from the non-agricultural sector, and (iii) urban males.

4. Testing for external effects of education on earnings

To test for external effects of literacy we assume that the labor earnings, W_j, of an illiterate worker are determined by:

$$\log W_j = \alpha LIT_j + X_j\beta + \varepsilon_j \qquad (6)$$

where LIT_j is a dummy variable taking the value one if at least one other person in the household is literate (defined as being able to read), X_j is a (1xK) vector of control variables for person j comprising other factors relevant to the worker's productivity and hence wages, including experience. (The first element of X_j is 1 to allow for an intercept.) The parameter α measures the external effect of the family's literacy on the worker's earnings, and β is a (Kx1) vector of parameters on worker characteristics. The error term ε_j is assumed to be normally distributed with mean zero and standard deviation σ.

There are two problems in estimating the test regression in (6). The first is the classic problem of estimating wage equations, namely that one only observes wages for those individuals who have chosen to enter the (paid) work force. We assume that wage earnings for person j are observed if and only if

$$\delta LIT_j + Z_j\gamma + u_j > 0 \qquad (7)$$

where Z_j is a (1xM) vector of regressors for person j, whose first element is 1 and other elements are M-1 regressors and γ is a (Mx1) vector of parameters. Equation (7) is interpreted as a model of the individual's labor force participation decision. The error term u_j is standard normal with a non-zero correlation coefficient (Δ) with ε_j. Then we can use the maximum-likelihood Heckman selection model to correct for any selection bias. The expected value of observed log earnings is then $\alpha LIT_j + X_j\beta + \rho\sigma_\varepsilon\lambda(\delta LIT_j + Z_j\gamma)$ where λ is the usual inverse Mills ratio. We can separately identify α from δ even if $X_j = Z_j$ given that λ is a non-linear function. One of our tests will exploit this fact. However, our main results will also make a widely-used identifying assumption in estimating earnings regressions with selectivity, namely that certain household characteristics influence participation, but do not influence earnings given participation.

In the wage equation, the explanatory variables in the vector X include age of the earner, square of the age, a dummy variable that takes the value 1 if the earner has been to school,[6] and the variables that proxy the maximum level of education in each household. To allow for geographic effects, a series of regional dummies are also included that take the value 1 depending on the region a particular earner belongs to completes the list of independent variables in the wage equation.

In the probit selection equation, the list of variables in the vector Z includes all the independent variables in the wage equation, along with variables that represent household characteristics that are deemed to determine participation in the workforce. This latter group of variables includes dummies for land holdings, and demographic characteristics including characteristics of the household head. In the case of females with primary earnings from the non-agricultural sector, dummies for whether the household is rural or urban are also included as

[6] A small number of persons in our sample have been to school but remain illiterate.

explanatory variables; in the case of urban males, a dummy for whether the household is from a metropolitan area or not is included as an explanatory variable. However, we will also test robustness of our results to including in X all the variables in Z, and exploiting the non-linearity of the inverse Mills ratio for identification.

The second problem in estimating our test equation (6) is bias due to possible endogeneity of LIT_j. We can suggest two possible reasons for such a bias. One is that illiterate workers make choices about the extent of schooling in their family. Those choices are presumably through selective mating and the schooling choices parents make for their children. By this argument, there is some hidden characteristic of the illiterate worker that is both positively correlated with wages and the presence of another literate person in the household. This would create a reverse causation in our test equation, arising from the fact that people with higher earnings, in spite of being illiterate themselves, can afford to educate their children more in comparison to people with lower incomes; higher earnings may also help them attract a literate spouse. These effects could be interpreted as literacy externalities in their own right, though they need not operate on earnings; a high wage illiterate worker may derive utility from having a literate spouse or child even if this effect does not yield higher wages for that worker.

Another reason to suspect endogeneity bias in (6) is that the presence of literacy may be correlated with other measures of the extent of schooling in the family, which may also matter to the earnings of an illiterate worker. Possibly it is not literacy that gives the external benefit, but the extent of schooling more generally. This would be consistent with the proposition that schooling has external effects on earnings, though it would bias our estimates of the effects of literacy per se.

In response to these concerns, we perform two tests of the robustness of our estimates of α to endogeneity of LIT_j. In the first, we restrict the sample to unmarried workers, on the assumption that marriage is the main way in which a high wage illiterate worker can influence the extent of literacy in her or his family. The wage and probit equations in each case have the same specifications as before, with the difference that the estimates are now based only on the unmarried people belonging to each group. This test will not however be robust to other forms of selective family formation. For example, an unmarried illiterate worker may choose to continue living with a literate parent or sibling so as to assure that the external gains from literacy are captured; higher earning ability may help assure that this is possible.

In the second test, we add control variables measuring the extent of schooling in the family; we use the highest years of schooling reached.

5. Results

We estimate equations (6) and (7) for the following sub-groups:

(i) Women with primary earnings from the non-agricultural sector. Here the dependent variable in the wage equation is the log of earnings of individuals in this group. In the probit estimated on the full sample of illiterate females, the dependent variable takes the value 1 if an individual's earnings are observed and if her primary earnings are from the non-agricultural sector, and 0 otherwise.

(ii) Rural males with primary earnings from the non-agricultural sector. The dependent variable in the wage equation is the log of earnings of individuals in this group. In the probit estimated on the entire sample of rural males, the dependent variable takes the value 1 if an individual's earnings are observed and if his primary earnings are from the non-agricultural sector, and 0 otherwise.

(iii) Urban males. The dependent variable in the wage equation is the log of earnings of individuals in this group. In the probit estimated on the entire sample of urban males, the dependent variable takes the value 1 if an individual's earnings is observed.[7]

In each of these cases, three models are estimated – one with literacy as the only household-education variable, a second in which the sample is restricted to unmarried workers, and a third with dummy variables for other levels of education.

Table 1 summarizes the results. (The Addendum gives full details on the wage regressions and participation probits used to correct for selectivity bias.)

We find a large and significant effect of family literacy on the wages of illiterate working women. Living in a household with a literate member adds 0.50 to log earnings of illiterate women, and the effect is highly significant. This implies that illiterate women can expect their earnings to be 65% higher if someone is literate in their family. This effect is robust to restricting the sample to unmarried women; indeed, the gain in log earnings rises to 0.74. This implies that an illiterate female worker from a family with at least one literate member has about double the earnings as one from a family where everyone else is also illiterate.

Women's labor force participation, by contrast, is significantly lower when an illiterate worker lives in a literate household, and the effect is similar between married and unmarried women.

We find significant gains to illiterate males working in both the urban and rural non-farm sectors of living in a household where at least one other person is literate. The gain in log earnings is about 0.14-0.15, implying that earnings of illiterate men are on average 15% higher if

[7] The Addendum also gives results for rural males with primary earnings from the agricultural sector; in this case the dependent variable in the wage equation is the log of earnings of individuals belonging to this group. In the probit which is estimated on the entire sample of rural males, the dependent variable

they come from a family where at least one person is literate. However, this effect is not robust to restricting the sample to unmarried workers; the effect is no longer statistically significant. For urban males the effect vanishes.

Labor-force participation of illiterate rural men is significantly higher if they live in a literate household, although the effect is barely significant at the 5% level. Nor is this effect found for unmarried men. The labor-force participation of urban illiterate men is not changed significantly by living in a literate family.

The above tests do not make any distinction between the external effect of having a male versus female literate family member. To test the possibility that different genders generate different external gains from literacy, we re-ran the tests including two extra dummy variables. One of these variables was for whether the literates are only male, and one was for whether they are only female (the left out category was the case in which there are both males and female literate family members). The coefficients on these dummy variables were small and (individually and jointly) insignificant in almost all the wage regressions. The one exception was the dummy variable for "male-only" literates in the womens' wage regression, for which there the coefficient was -0.361 suggesting an attenuation of the external gain to women workers in households where only men are literate; however, the coefficient was only significant at the 8% level (t=1.76).

Similarly, we tested for whether age of the literate member matters. We added dummy variables for whether all literates were under 16, or over 16 (again the mixed case was omitted). These were individually and jointly insignificant in all of the wage regressions.

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takes the value 1 if an individual's earnings are observed and if his primary earnings are from the agricultural sector, and 0 otherwise.

We also tested how robust these results are to the specification of the variables to be included as controls in the wage regression (comprising the vector X in equation (4)). Possibly the most contentious restriction we have imposed is that household landholding only influences earnings via its effect on the correction term for labor force participation, i.e., landholding does not have a direct effect on labor earnings. The final column in Table 1 gives the results when we include dummy variables for landholding class in the wage regression. The estimated effects of family literacy are similar to the first model.

Table 2 presents selected results from the wage and participation regressions which also included controls for other schooling in the household. (The Addendum gives full details.) The literacy effect on earnings is still strong for women. And there is a very strong effect of high education levels. The significant negative effect of family literacy on female labor-force participation is found to be due to higher schooling rather than literacy per se.

For both rural and urban male workers, the positive effect of family literacy on earnings is still present when one adds controls for other family members' schooling, but it is not significant. Instead we get a significant positive effect of family schooling. For rural males, participation in non-farm work is not changed significantly by family literacy; for urban men, higher levels of family schooling attenuate their labor-force participation.

So, while we find some signs that literacy in the family increases an illiterate man's earnings, this is not robust to adding controls for higher levels of education in the family. This is not of course inconsistent with external effects of education. However, it does lead us to question whether it is the fact of literacy that is driving the results for males, or something else.

The external effects of family literacy and schooling on the earnings of illiterate women that we find are very strong indeed, and much stronger than for men. Why might this be? We can suggest the following explanations.

One might conjecture that women have less power to influence the literacy of their family than do men. Social sanctions on women's' behavior might limit their ability to choose a partner, while men are less constrained. Or possibly men have greater influence over whether the children are sent to school. If there are in fact pecuniary gains to an illiterate worker from having at least one literate person in the family then men may well be better able to capture the external effects of literacy through family formation than are women. We would then find less variance in family schooling for males than females.

This explanation is not, however, easily reconciled with our finding that the external effect of family literacy for illiterate males drops out when we confine attention to unmarried males. If this explanation were right, then we would surely expect a stronger effect to emerge for unmarried males than married ones.

We believe that a more plausible explanation is that illiterate women in Bangladesh are much more dependent on their family for assistance with tasks that require reading and writing than are illiterate men. There are sources of help in reading and writing for illiterate workers, including paying for the services of a scribe. However, cultural and religious sanctions on women's social activities may well entail that they have a harder time than men in accessing these sources of help outside the family. This effect would be no weaker we suspect, and possibly stronger, for unmarried than married men.

Finally, women may well be better able to absorb the benefits of household literacy. They may, for instance, be unencumbered by pride or other defenses which could render one unable to learn easily from others.

6. Conclusions

Intuition and piecemeal evidence suggest that literacy has positive externalities on earnings of others in the household. That is, a literate person is likely to share some of the benefits of his or her literacy with other members of the household. This means that it is better to be an illiterate in a household where there is someone literate than in a household of only illiterates.

We have tested this hypothesis in two ways. Firstly, we have asked whether it can be derived from a consistent set of assumptions about household behavior. Our theoretical analysis of the household, based on the contemporary approach of the collectivist model of the household, confirms that it can make sense for agents to share their education with others in the household. Secondly, we have tested if the hypothesis stood up to systematic scrutiny in earnings data for Bangladesh. We found that it not only stands up, it does so with a considerable amount of robustness.

The empirical investigation has yielded insights deeper than what we had anticipated on the basis of theory and intuition. It is, for instance, widely noted that a literate mother confers greater benefits on the children than a literate father. But what about differences between male and female *recipients*? Is there any reason to believe that a female is better able to absorb the benefits of literacy in the household than a male illiterate? While theory suggests that they can have differences, it gives no hint as to which way this may go. Our empirical results suggest that women are more efficient recipients.

Table 1: Effects of Family Literacy on the Earnings and Labor Force Participation of Illiterate Non-Farm Workers

		Full sample	Unmarried sample only	With land effects on earnings
Women	Earnings (α)	0.504 (4.577)	0.737 (4.477)	0.487 (4.368)
	Participation (δ)	-0.256 (-3.512)	-0.290 (-2.353)	-0.253 (-3.527)
Men (rural)	Earnings (α)	0.146 (2.769)	0.143 (1.127)	0.143 (2.636)
	Participation (δ)	0.110 (1.980)	0.113 (1.125)	0.111 (1.991)
Men (urban)	Earnings (α)	0.144 (2.274)	-0.031 (-0.251)	0.136 (2.405)
	Participation (δ)	-0.023 (-0.153)	-0.023 (-0.153)	-0.151 (1.800)

Note: Gain in log earnings of an illiterate worker attributed to literacy within the household. Log earnings regressions include correction for sample selectivity bias as well as controls for worker characteristics (age, age squared, if any school attendance, and regional effects). t-ratios in parentheses.

Table 2: Effects of Family Literacy and Schooling on the Earnings and Labor Force Participation of Illiterate Non-Farm Workers

		There is another literate person in the household	Highest schooling in the household		
			Completed Class I+	Completed Class IV+	Completed Class VII+
Women	Earnings	0.462	0.186	-0.311	0.757
		(2.578)	(1.510)	(-1.628)	(4.154)
	Participation	0.102	-0.249	-0.223	-0.196
		(0.866)	(-2.678)	(-1.820)	(1.705)
Men (rural)	Earnings	0.104	0.152	-0.042	-0.053
		(1.252)	(2.225)	(-0.495)	(-0.613)
	Participation	0.016	-0.069	0.171	0.012
		(0.189)	(-0.949)	(1.953)	(0.145)
Men (urban)	Earnings	0.048	0.056	-0.020	0.271
		(0.493)	(0.743)	(-0.205)	(2.736)
	Participation	0.005	0.001	0.026	-0.460
		(0.004)	(0.008)	(0.187)	(-4.075)

Note: Log earnings regressions include correction for sample selectivity bias as well as controls for worker characteristics (age, age squared, if any school attendance, and regional effects). t-ratios in parentheses.

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